CLAIMS

We claim

1. A display system, comprising:

a light source providing a light beam;

a spatial light modulator, further comprising:

an array of micromirrors for reflecting the light beam;

an array of electrodes and memory cells for driving the micromirrors to reflect the light beam according to a set of bitplane data of an image stored in the memory cells; and

a set of circuitry providing the set of bitplane data and a first set of control signals sufficient for the electrodes and memory cells to drive the micromirrors so as to produce the image, the first set of control signals being provided in accordance with a second set of control signals received by the circuitry;

an integrated driver built on a single chip providing the bitplane data of the image and a third set of control signals comprising the second set of control signals; and

an optical element for steering the light beam.

2. The system of claim 1, wherein the integrated driver further comprises:

a control unit providing the third set of control signals; and

a data processing unit providing the set of bitplane data of the image.

3. The system of claim 1, wherein the integrated driver further comprises:

a first bus on the control unit; and

a second bus on the data processing unit, wherein the second bus is linked to the first bus through a bridge.

4. The system of claim 2, wherein the bridge further comprises:

a means for transmitting a control signal from the first bus to the second bus and the a control signal from the second bus to the first bus; and

a means for transmitting a data signal from the first bus to the second bus while blocking a data signal originated from the second bus.

5. The system of claim 2, further comprising:

a first bus controller connected to the first bus; and

a second bus controller connected to the second bus.

6. The system of claim 3, wherein the first bus controller further comprises:

a means for monitoring a data signal originated from a first module connected to the first bus; and

a means for determining a target module for responding to the data signal.

7. The system of claim 3, wherein the first bus controller further comprises:

a means for monitoring a data signal addressed to the second bus; and

a means for instructing the bridge to transmit the data signal from the first bus to the second bus.

8. The system of claim 5, wherein the second bus controller further comprises:

a means for monitoring the data signal transmitted from the bridge; and

a means for instructing a module connected to the second bus to respond to the data signal.

9. The system of claim 3, wherein the second bus controller further comprises:

a means for determining, between a first module and a second module, which module is to be activated first when the two modules request to be activated simultaneously.

10. The system of claim 3, further comprising:

a first clock connected to the first bus; and

a second clock connected to the second bus.

11. The system of claim 8, wherein the second clock is a derivative of the first clock.

12. The system of claim 8, wherein the first and second clocks both are connected to a central clock.

13. The system of claim 1, wherein the control unit of the integrated driver further comprises:

a means for initializing the data processing unit.

14. The system of claim 1, wherein the spatial light modulator further comprises:

an array of electrodes, each of which is associated with a micromirror of the micromirror array; and

an array of memory cells, each of which is connected to an electrode of the electrode array.

15. The system of claim 11, wherein the memory cell array further comprises:

a row of memory cell array having at least a first and second groups; and

a first wordline and a second wordline provided for the row such that memory cells of the same group are connected to the same wordline and the memory cells of different groups are connected to separate wordlines.

16. The system of claim 12, further comprising:

a mirror driver, further comprising:

a wordline decoder in connection with the first and second wordlines of the row of the memory cells;

a bitline decoder in connection with the memory cells for updating the memory cells; and

a mirror control unit in connection with the wordline decoder, the bitline decoder and the data processing unit for controlling the update of the memory cells.

17. The system of claim 13, wherein the mirror control unit further comprises:

a means for providing a wordline signal having a first and second values, wherein the first value represents an activation of the first wordline and a deactivation of the second wordline, and the second value represents a deactivation of the first wordline and an activation of the second wordline.

18. The system of claim 14, wherein the memory cell further comprises:

a transistor having a source that is connected to the bitline, a gate that is connected to one of the two wordlines and a drain; and

a capacitor having a first plate connected to the drain of the transistor and a second plate connected to a pumping line that is not grounded.

19. The system of claim 15, wherein the mirror controller further comprises:

a means for providing a pumping signal for the pumping line.

20. The system of claim 1, further comprising:

a color wheel that is in connection to the control unit of the integrated driver; and wherein the control unit further comprises:

a means for providing a control signal for coordinating the operation of the color wheel to the operations of the light source and the spatial light modulator.

21. The system of claim 14, wherein the system further comprises: a buffer in connection with the mirror control unit, wherein the buffer comprises at least a first and second sections, the first section having a set of bitplane data for the memory cells connected to the first wordline and the second section having another set of bitplane data for the memory cells connected to the second wordline.

22. The system of claim 1, wherein the control unit of the integrated driver further comprises: a means for receiving and responding to a control signal originated from a user of the display system.

23. A projector, comprising:

a light source providing a light beam;

a spatial light modulator comprising an array of the micromirrors that reflect the light beam according to a set of bitplane data of an image under a control of a first set of control signals so as to produce an image;

an integrated driver built on a single chip providing the set of bit plane data and the first set of control signals; and

imaging optics for projecting the reflected light beam onto a display target.

24. The projector of claim 23, wherein the spatial light modulator further comprises:

an array of electrodes, each of which is associated with a micromirror of the micromirror array;

an array of memory cells, each of which is associated with an electrode of the electrode array;

a set of circuitry for updating the memory cells with the set of bitplane data; and

a backplane controller providing the first set of control signals and the set of bitplane data.

25. The projector of claim 24, wherein the integrated driver further comprises:

a control unit; and

a data processor in connection with the control unit, an image data source and the spatial light modulator, the data processor providing a second set of control signals comprising the first set of control signals.

26. The projector of claim 25, wherein the spatial light modulator further comprises:

a first set of wordlines and a second set of wordlines connected to the memory cells such that for a row of the memory cell array, a first portion of the memory cells are connected to a wordline from the first set, and a second portion of the memory cells are connected to another wordline from the second set.

27. The projector of claim 26, wherein the first portion of the memory cells are even numbered memory cells in the row, and the second portion of the memory cells are odd numbered memory cells in the row.

28. The projector of claim 27, wherein the first set of control signals comprises:

a wordline signal having a first value and a second value, the first value representing an activation of the wordlines from the first set of wordlines, the second value representing an activation of the wordlines from the second set of wordlines.

29. The projector of claim 24, wherein the memory cell of the memory cell array further comprises:

a transistor, further comprising:

a source connected to a bitplane;

a gate connected to a wordline; and

a drain; and

a capacitor, further comprising;

a first plate connected to the drain of the transistor; and

a second plate connected to a pump line that comprises at least two voltage levels.

30. The projector of claim 29, wherein the first set of control signals further comprises: a pumping signal for the pump line.

31. A method of producing an image using a display system having a spatial light modulator that comprises an array of micromirrors that are individually movable, the method comprising:

initializing, by a control unit of an integrated driver, the display system, further comprising:

sending a set of initializing data to a first bus of the control unit;

transmitting the initializing data to a second bus of a data processing unit of the integrated driver through a bridge that links the first and second buses;

loading a sequence of image data of the image into the data processing unit;

transforming the image data into a sequence of bitplane data;

delivering a set of display data comprising a set of display control signals and the bitplane data into a display control unit of the spatial light modulator;

in accordance with the display control signals, the display control unit sending the bitplane data to an array of memory cells, each of which is associate with a micromirror for deforming the micromirrors so as to produce the image.

32. The method of claim 31, wherein the step of initiating the display system further comprises:

sending a set of control signals and a set of parameters to the first bus; and

instructing the bridge to transmit the set of control data and the set of parameters to the second bus.

33. The method of claim 32, further comprising:

blocking a data signal originated from the second bus to be transmitted to the first bus.

34. The method of claim 33, further comprising:

transmitting a control signal from the second bus to the first bus through the bridge.

35. The method of claim 31, further comprising:

upon receiving a control signal for adjusting the set of initiation parameters by the control unit of the integrated driver, adjusting the initiation parameters.

36. The method of claim 32, further comprising:

upon receiving the set of control signals and the set of parameters, initiating the data processing unit of the integrated driver.

37. The method of claim 31, wherein the steps of transforming the image data and delivering the set of display data are performed by separated modules both connected to the second bus.

38. The method of claim 37, further comprising:

scheduling the transforming and delivering steps at different times.

39. The method of claim 31, further comprising:

storing the bitplane data in a frame buffer;

retrieving the stored bitplane data from the frame buffer; and

delivering the retrieved bitplane data to the memory cells.

40. The method of claim 39, further comprising:

providing a first and second wordlines to a row of the memory cell array such that each wordline is connected to different memory cells of the row.

41. The method of claim 40, wherein the step of transforming the image data into bitplane data further comprises:

separating the bitplane data into a set of subgroups with the bitplane data in each group corresponding to the memory cells connected to one wordline.

42. The method of claim 41, wherein the step of separating is executed along with the step of transforming the image data in to bitplane data.

43. The method of claim 41, further comprising:

storing the bitplane data such that the bitplane data for the memory cells connected to the same wordline are stored consecutively.

44. The method of claim 40, further comprising:

connecting the even numbered memory cells of the row to a first wordline and the odd numbered memory cells to a second wordline.

45. The method of claim 43, further comprising:

loading the bitplane data for the row of the memory cells; and

activating a portion of the memory cell of the row with the loaded bitplane data.

46. The method of claim 45, further comprising:

activating the memory cells connected to the first wordline;

updating the activated memory cells with the loaded bitplane data;

deactivating the memory cells of connected to the first wordline;

activating the memory cells connected to the second wordline; and

updating the activated memory cells with the loaded bitplane data.

47. The method of claim 43, further comprising:

loading the bitplane data stored in the first section of the frame buffer;

activating the first wordline;

updating the activated memory cells with the loaded bitplane data; and

deactivating the first wordline.

48. The method of claim 47, further comprising:

loading the bitplane data stored in the second section of the frame buffer

activating the second wordline; and

updating the memory cells activated by the second wordline with the loaded bitplane data.

49. The method of claim 31, further comprising:

providing the memory cell such that the memory cell has a transistor and a capacitor having a first and second plates; and

connecting the source of the transistor to a bitplane, the drain to the first plate of the capacitor, the gate to one of the wordlines and the second plate of the capacitor to a pumping line that is not grounded.

50. The method of claim 49, further comprising:

providing, by the display control unit, a pumping signal to the pumping line.

51. The method of claim 31, further comprising:

providing a color wheel;

connecting the color wheel to the control unit of the integrated driver; and

providing a synchronization signal to the color wheel so as to coordinate the color wheel with the micromirrors.

52. A spatial light modulator for use in display systems, comprising:

an array of micromirrors, each of which is operable to rotate;

an array of electrodes, each of which is associated with a micromirror of the micromirror array;

an array of memory cells, each of which is connected to an electrode of the electrode array;

a plurality of bitlines, each of which is connected to a memory cell for updating the memory cells;

a first and second sets of wordlines connected to the memory cells for activating the memory cells, wherein the memory cells of a row of the memory cell array are separately connected to a first wordline from the first wordline set and a second wordline from the second wordline set; and

a mirror driver in connection with the bitlines and the first set of wordlines, further comprising:

a control unit providing a wordline control signal that selectively activates and deactivates the wordlines from the first and second sets of the wordlines.

53. The spatial light modulator of claim 52, further wherein the memory cell further comprises:

a transistor having a source connected to the bitline, a gate connected to a wordline, and a drain; and

a capacitor having a first plate connected to the drain and a second plate connected to a pump line.

54. The spatial light modulator of claim 53, wherein the control unit further providing a pump signal for the pump line.

55. A method for driving an array of micromirrors of a spatial light modulator used in a display system, wherein the spatial light modulator comprises an array of micromirrors, each of which being associated with an electrode of an array of electrodes, each electrode being connected a memory cell of an array of memory cells, the method comprising:

connecting the memory cells to a first and second sets of wordlines such that, for a row of the memory cell array, the memory cells of the row are separately connected to at least a wordline from the first set and another wordline from the second set;

connecting the each memory cells of a column to a bitline;

upon receiving a display control signal and a set of data, generating a wordline control signal having a first value and a second value;

activating the wordlines from the first set;

delivering the data to the memory cells connected to the activated wordlines;

deactivating the wordlines from the first set;

activating wordlines from the second set; and

delivering the data to the memory cells connected to the activated wordlines.

56. The method of claim 55, further comprising:

producing a pump signal; and

delivering the pump signal to the pump line.

57. A method for driving an array of micromirrors of a spatial light modulator used in a display system, wherein the spatial light modulator comprises an array of micromirrors, each of which being associated with an electrode of an array of electrodes, each electrode being connected a memory cell of an array of memory cells, the method comprising:

connecting the memory cells to a first and second sets of wordlines such that, for a row of the memory cell array, the memory cells of the row are separately connected to at least a wordline from the first set and another wordline from the second set;

connecting the each memory cells of a column to a bitline;

upon receiving a display control signal;

generating a wordline control signal that selectively activates and the deactivates the wordlines;

updating the memory cells of a row, further comprising:

loading a first set of data for the memory cells connected to the first wordline of the row;

activating the first wordline

delivering the first set of data to the memory cells connected to the activated first wordline;

deactivating the first wordline;

loading a second set of data for the memory cells connected to the second wordline;

activating the second wordline; and

delivering the data to the memory cells connected to the activated second wordline.

58. The method of claim 57, further comprising:

providing a pump signal; and

delivering the pump signal to the pump line.

59. the method of claim 57, further comprising:
updating the memory cells.